ELEC 544 - Digital Signal Processing - 2016

Instructor: C. Sidney Burrus, **Office**: Abercrombie 223A, Phone 5484, e-mail csb@rice.edu

Class: MWF at 10:00 am, Duncan-1075; Office hours: 11-12 MWF or by appointment

Structure: Three one-hour classes per week the first half or 2/3 of the semester, Two in-class, closed-book exams, computer assignments using *Matlab*, a project is done the second half of the semester and a report presented and turned in. Course will be somewhat "flipped", meaning reading, video viewing, homework will be done at home before class and it will be discussed in class.

Information on *OwlSpace:* https://owlspace-ccm.rice.edu/portal/site/ELEC-544-001-Sp16

Prerequisite: Basic linear system theory that would cover Fourier analysis and frequency response. Introduction to discrete time systems (301 or 431) Computer programming (Matlab) is necessary.

Student The course is suitable for seniors or graduate students majoring in any engineering, science, mathematics, or social science discipline.

Course Outline:

1. Review

- The DFT, z-transform, convolution, frequency response

2. Filter Design

- Approximation and realization
- FIR and IIR filters
- Multirate filters and filter banks

3. DSP Algorithms

- Fast Fourier Transform (FFT), sparse FFT
- Wavelet Transform
- High-Speed Convolution and correlation

4. Wavelet Theory and Transforms

- Multiresolution theory
- Filter bank theory
- Denoising and compression

5. Project: Groups of 2 or 3 will propose a project on filter design, algorithms, or wavelets and carry it out during the second half of the semester

Texts, Notes, and Reference Books (recommended, not required):

1. Burrus: *Digital Signal Processing and Filter Design*, Draft Book, Connexions and OpenStax and OwlSpace. http://cnx.org/content/col10598/latest/

2. Burrus: *Fast Fourier Transforms*, Connexions and OpenStax and OwlSpace. http://cnx.org/content/col10550/latest/

3. Burrus, et al: *Computer Based Exercises for Signal Processing using MatLab*, PH, 1994, 98

4. Burrus, Gopinath, and Guo: *Introduction to Wavelets and Wavelet Transforms*, PH, 1998. Also in Connexions: http://cnx.org/content/col11454/latest/

5. Baraniuk: *Signals and Systems*: OpenStax, Connexions http://cnx.org/content/col10064/latest/

6. Sharf: *A First Course in Electrical and Computer Engineering*, OpenStax, Connexions, http://cnx.org/content/col10685/latest/

7. Burrus: *A Brief Note on Signals and Systems*, OpenStax, Connexions http://cnx.org/content/col10565/latest/

8. Vetterli, Kovacevec, and Goyal: *Foundations of Signal Processing*, Cambridge Press, 2014

9. Kovacevic, Goyal, and Vetterli: *Fourier and Wavelet Signal Processing*, 2014, Online at www.fourierandwavelets.org

10. Burrus: *Basic Vector Space Methods in Signal and Systems Theory*, OpenStax, Connexions http://cnx.org/content/col10636/latest/

11. Eldar, Yonina C.: *Sampling Theory: Beyond Bandlimited Systems*, Cambridge Press, 2015

12. Mallat, Stephane: *A Wavelet Tour of Signal Processing: The Sparse Way*, Academic Press, 2009, also OpenStax Connexions: https://legacy.cnx.org/content/col10711/latest/

Any student with a disability requiring accommodations in this course should contact me after class by coming to my office, sending email, or by phone.